98 P 7261

PCT WORLD INTELLE[illegible]

INTERNATIONAL APPLICATION PUBLISH[illegible]

WO 9604760A2

(51) International Patent Classification 6 : B3
H04Q 7/34, 7/38

A2

(11) International Publication Number: **WO 96/04760**

(43) International Publication Date: 15 February 1996 (15.02.96)

(21) International Application Number: PCT/FI95/00403

(22) International Filing Date: 17 July 1995 (17.07.95)

(30) Priority Data:
943446 20 July 1994 (20.07.94) FI

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(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG).

Published
In English translation (filed in Finnish).
Without international search report and to be republished upon receipt of that report.

(54) Title: METHOD FOR MEASURING THE NOISE LEVEL OF A BASE STATION ENVIRONMENT

CH	BTS RX-BAND	MS RX-BAND
f1	- 100 dBm	—
f2	- 102 dBm	—
.	.	.
.	.	.
.	.	.
f9	—	- 99 dBm
f10	—	- 90 dBm

(57) Abstract

The invention relates to a method for measuring the disturbance level of a base station environment, which base station (BTS1) comprises at least one receiver (TRX) utilizing frequency hopping, and means for measuring the signal level (RSSI) of signals received by said receiver. In order to carry out the measurements quickly and with ease, a free traffic channel is allocated in the receiver (TRX), said traffic channel is made hop sequentially through those frequency channels (f1 - f5) which the base station (BTS1) uses for reception, and the signal levels (RSSI) of the signals received on said frequency channels (f1 - f5) are measured, and a report on the measurement results is transmitted to the operator. The invention further relates to a cellular communication system which can utilize the method of the invention.

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Method for measuring the noise level of a base station environment

The present invention relates to a method for measuring the disturbance level of a base station environment, which base station comprises at least one receiver utilizing frequency hopping, and means for measuring the signal level of signals received by said receiver. The invention further relates to a cellular communication system comprising a mobile switching centre, a base station controller and base stations, whereby the system comprises a base station with at least one receiver utilizing frequency hopping, and means for measuring the levels of the signals received by the receiver.

The present invention relates to spectral analysis carried out in the base station environment, the object of the analysis being to detect and locate the factors disturbing the system. In a prior art solution for measuring the disturbance level in a base station environment of a cellular communication system, a separate spectrum analyzer is taken to the base station site whenever problems occur. The spectrum analyzer is then used for monitoring possible disturbances by measuring the signal levels of the received signals on all the frequency channels used by the base station. In cases where the disturbance that disturbs the operation of a base station is sporadic (a fast data link, for example), it has even been necessary to wait for its occurrence.

The solution described above for measuring the disturbance level is very slow and expensive as it requires, in addition to a separate measuring device, an active part from the service personnel during the

measurements as well as for the handling and transportation of the spectrum analyzer.

The object of the present invention is to solve the aforementioned problems and offer a more user friendly and faster method for carrying out disturbance level measurements in a base station environment. This object is achieved by the method of the invention which is characterized by allocating a free traffic channel in the receiver, making said traffic channel hop from one receive frequency channel of a base station to another, and measuring the signal levels of the signals received on said frequency channels, and transmitting a report on the measurement results to the operator.

The present invention further relates to a cellular communication system in which the method of the invention can be utilized. It is characteristic to the system of the invention that a base station comprises measuring means for making a traffic channel hop from one receive frequency channel of a base station to another, and for measuring the signal levels of the signals received on said frequency channels, as well as transmitting a report on the measurement results to the base station controller.

The invention is based on the idea that measuring disturbance level of a base station environment is made considerably easier and faster as the measurements are carried out by making a free traffic channel of a base station hop so that it goes through all the receive frequency channels of the base station, and measures the levels of signals received on said channels. If the base station is sectorized, the measurements can be carried out, for example, in one sector at a time.

In a time divisional (TDMA) communication system, disturbance level measurements strain the

traffic capacity of the base station very little, because the measurements can be carried out by using a single time slot. On the other hand, if the communication system in question is not of time divisional type, this means that the disturbance level measurements take up the entire capacity of a receiver for the duration of the measurements. Disturbance level measurements in accordance with the present invention can easily and with only minor modifications be applied to in existing communications systems, because in many systems the receiver of the base station already comprises the necessary measuring means for measuring the signal level of the received signal. The invention can be applied to such systems by adding a computer programme to them for controlling the test. Thus, the most significant advantages of the method and system of the invention are simplicity, easy and quick implementation, modest capacity requirements, and a possibility for an automatic continuous control without any need for the operator to even know about the execution of the test if the system does not alarm the operator due to abnormal measurement results.

In a preferred embodiment of the system of the invention, a base station is provided with a prior art STM (Site Test and Measurement) unit. A site test and measurement unit such as this, simulating the operation of an ordinary mobile station, is in common use in, for example, base stations of the GSM (Groupe Spécial Mobile) system. In this preferred embodiment of the invention, the receiver of the site test and measurement unit is made hop sequentially to the frequency channels which are used for transmitting by the base station in which case the receiver of the unit measures the levels of signals received on said frequency channels. This embodiment of the invention can be applied to, for

example, a base station of the GSM system in which every transceiver is of full-duplex type, and the duplex spacing between their transmit and receive frequencies is 45 MHz. Thus, a frequency hopping receiver measures the receive frequencies of the base station, and the receiver of the frequency hopping site test and measurement unit measures the transmit frequencies of the base station (i.e. the receive frequencies of mobile stations).

The preferred embodiments of the method and system of the invention are illustrated in the attached dependent claims 2 - 4 and 6 - 10. In the following, the invention will be described in greater detail by means of examples with reference to the attached drawings in which

figure 1 is a block diagram illustration of a base station,

figure 2 illustrates measurement results transmitted from the base station of figure 1 to a base station controller,

figure 3 is a block diagram illustration of a part of a cellular communication system,

figure 4 illustrates measurement results transmitted from the base station controller of figure 3 to a mobile switching centre, and

figure 5 illustrates a preferred embodiment of a method of the invention.

Figure 1 shows a block diagram of a base station BTS1 of the GSM system. The structure and operation of the GSM system is described, for example, in "The GSM System for Mobile Communications", by M. Mouly & M-B Pautet, Palaiseau, France, 1992, ISBN: 2-9507190-0-7, and so, they are not described here in any closer detail.

The base station BTS1 (Base Transceiver Station) of figure 1 comprises three transceivers TRX which, through a combined transmit and receive antenna ANT, communicate with mobile stations within the radio coverage area of the base station at any given moment of time. Each transceiver TRX is of full-duplex type and there is a duplex spacing of 45 MHz between its receive and transmit frequencies. The receive units TRX comprise measuring means for measuring the power level RSSI (Received Signal Strength Indication) of the received signals in a way known per se.

The operation of a base station BTS1 is controlled by an OMU (Operation and Maintenance Unit) communicating with the BSC1 (Base Station Controller), and which controls the synthesizer frequency hopping of the transceivers TRX so that the base station BTS1 receives radio signals on the frequency channels f1 - f5, and transmits signals on the frequency channels f6 - f10. The operation and maintenance unit OMU further controls an STM (Site Test and Measurement Unit) which is provided in connection with the base station BTS1, which STM unit can simulate an ordinary subscriber unit by transmitting radio signals to the base station BTS1.

The base station controller BSC1 of figure 1 comprises means for activating the operation and maintenance unit OMU and the site test and measurement unit STM for measuring the disturbance level of a base station environment. In such a case, the operation and maintenance unit allocates a free traffic channel, i.e. a time slot, in a transceiver TRX of the base station. Following this, the operation and maintenance unit determines a frequency hopping sequence for the selected time slot, whereby all the frequencies f1 - f5 which the base station uses for reception are gone through sequentially one by one by utilizing synthesizer

frequency hopping. The selected time slot remains on each given frequency channel for the time it takes for the receiver of the transceiver used to measure the signal level RSSI of the signals received on said frequency channel, i.e. approximately 1 second/frequency channel. As soon as the measurements have been carried out, the operation and maintenance unit OMU transmits the RSSI values measured by the receiver further to the base station controller BSC1.

While any one of receivers TRX of the base station is measuring the receive frequency channels of the base station, the operation and maintenance unit OMU directs the site test and measurement unit STM of the base station to measure the transmit frequencies f6 - f10 of the base station. This measurement is also performed by making the receiver of the site test and measurement unit STM hop from one frequency channel to another so that signal levels RSSI of the received signals can be measured from all the transmit frequencies f6 - f10 of the base station. The site test and measurement unit transmits the measurement results to the operation and maintenance unit OMU which, as soon as the measurements have been carried out, transmits them further to the base station controller BSC1.

The operation and maintenance unit OMU comprises means for correcting the measurements that have been carried out by taking into account signals of connections that take place through the base station. In other words, if a base station, for example, has an ongoing call on a certain frequency channel while the site test and measurement unit STM is carrying out measurements on the corresponding channel, this naturally shows in the measurement result. The operation and maintenance unit OMU is, however, aware of the used frequencies, and therefore is able to compensate the

measurement results prior to transmitting them to the base station controller BSC1.

Figure 2 illustrates measurement results that are transmitted from the base station BTS1 of figure 1 to a base station controller BSC1. The chart of figure 2 shows the levels (RSSI) of signals measured frequency channel specifically on the receive channels f1 - f5 (BTS-BAND) and on the transmit channels f6 - f10 (MS-BAND) of the base station.

Figure 3 is a block diagram illustration of a part of a cellular communication network, to which part the base station BTS1 of figure 1 belongs. Figure 3 shows a part of a GSM network which comprises a MSC (Mobile Switching Centre), base station controllers BSC and BSC1, base stations BTS and BTS1 and site test and measurement units STM provided with the base stations.

The base station controllers BSC and BSC1 of figure 3 comprise means for initiating disturbance level measurements in the base stations BTS and BTS1 coupled to them, and for receiving and processing the measurement results transmitted by the base stations. As soon as the base station controller BSC1, for example, has received the measurement results from all the base stations coupled to it (three of them in figure 3), it transmits, through a mobile switching centre MSC, a report to the operator indicating the measurement results of the different base stations.

Alternatively, the base station controller can compare the measurement results to values predetermined by the operator, and if the measured values significantly differ from the reference values, transmit an alarm to the operator through a mobile switching centre.

Figure 4 illustrates measurement results transmitted from the base station controller of figure

3 to the mobile switching centre. Thus, the report that is transmitted to the mobile switching centre shows, base station specifically, the signal strength RSSI measured on each frequency channel. Thus, it is very simple for the operator to monitor the disturbance levels in different parts of the network.

Figure 5 illustrates a preferred embodiment of the method of the invention. In block 10, the operator activates measurements of the disturbance level in the network by transmitting a message about it to the base station controllers, or alternatively, the mobile switching centre performs the activation automatically at predetermined time intervals.

In block 11, the base station controllers transmit a measuring message to the operation and maintenance unit of the base station. In block 12, the operation and maintenance unit (in each base station), while activating the site test and measurement unit for the test, allocates a free time slot in the receiver of the base station.

In block 13, the allocated time slot is made hop through all receive frequencies of the base station, and the receiver of the site test and measurement unit is made hop through all transmit frequencies of the base station. A RSSI value is measured for all the frequency channels used by the base station, which value is then transmitted to the operation and maintenance unit by the receiver of the base station and the receiver of the site test and measurement unit.

In block 14, the operation and maintenance unit transmits a report on the measurement results to the base station controller. The base station controller compiles all the reports sent by base stations coupled to it, and then, in block 15, transmits the reports

further to the mobile switching centre which informs the operator of them.

It should be understood that the description above and the attached drawings are only meant to illustrate the present invention. Different kinds of variations and modifications of the invention will be obvious for a person skilled in the art without departing from the scope and spirit of the attached claims.

Claims

1. A method for measuring the disturbance level of a base station environment, which base station (BTS, BTS1) comprises at least one receiver (TRX) utilizing frequency hopping, and means for measuring the signal level (RSSI) of signals received by said receiver, c h a r a c t e r i z e d by

allocating a free traffic channel in the receiver (TRX),

making said traffic channel hop sequentially through those frequency channels (f1 - f5) which the base station (BTS1) uses for reception, and measuring the signal levels (RSSI) of the signals received on said frequency channels (f1 - f5), and

transmitting a message on the measurement results to the operator.

2. A method as claimed in claim 1, in which method the base station (BTS, BTS1) is provided with a site test and measurement unit (STM), c h a r a c - t e r i z e d in that the receiver of the site test and measurement unit (STM) is made hop sequentially through those frequency channels (f6 - f10) which the base station (BTS1) uses for transmission, and the signal levels (RSSI) of the signals received on said frequency channels (f6 - f10) are measured, and a message on the measurement results is transmitted to the operator.

3. A method as claimed in claim 1 or 2, c h a- r a c t e r i z e d in that the measurement results are compared to predetermined values, in which case values that differ from said predetermined values are listed in the report transmitted to the operator.

4. A method as claimed in any one of claims 1 - 3, c h a r a c t e r i z e d in that said base station (BTS, BTS1) is a base station of a cellular

communication system, advantageously a base station of a GSM system.

5. A cellular communication system comprising a mobile switching centre (MSC), a base station controller (BSC, BSC1) and base stations (BTS, BTS1), whereby the system comprises a base station (BTS1) which comprises at least one receiver (TRX) utilizing frequency hopping, and means for measuring the signal level (RSSI) of signals received by said receiver, c h a r a c t e r i z e d in that the base station (BTS1) comprises measuring means (OMU) for making a traffic channel hop sequentially through those frequency channels (f1 - f5) which the base station uses for reception, and for measuring the signal level (RSSI) of the signals received on said frequency channels (f1 - f5), and for transmitting a message on the measurement results to the base station controller.

6. A system as claimed in claim 5, in which system the base station (1) is provided with a site test and measurement unit (STM), c h a r a c t e r i z e d in that the site test and measurement unit (STM) comprises means for making its receiver hop sequentially through those frequency channels (f6 - f10) which the base station (BTS1) uses for transmission, and for measuring the signal levels (RSSI) of the signals received on said frequency channels, and for transmitting a message on the measurement results to the base station controller (BSC, BSC1).

7. A system as claimed in claim 5, c h a - r a c t e r i z e d in that the capacity of said receiver (TRX) utilizing frequency hopping is divided into time slots in accordance with the TDMA principle, and that the measuring means (OMU) are provided with means for making a time slot hop in order to carry out disturbance level measurements.

8. A system as claimed in claim 5 or 6, c h a r a c t e r i z e d in that the base station controller (BSC, BSC1) is provided with means for activating the site test and measurement units (STM) and the measuring means (OMU) of all the base stations (BTS, BTS1) coupled to it, and for receiving the messages on the measurement results transmitted by said base stations (BTS, BTS1) and the site test and measurement units (STM), and transmitting a message on the measurement results to the mobile switching centre (MSC) of the system.

9. A system as claimed in claim 8, c h a r a c t e r i z e d in that the message on the measurement results transmitted by the base station controller (BSC, BSC1) to the mobile switching centre (MSC) contains base station (BTS, BTS1) specific information about signal levels measured on the frequency channels (f1 - f10) used by each base station.

10. A system as claimed in any one of claims 5 - 9, c h a r a c t e r i z e d in that said cellular communication system is a GSM system.

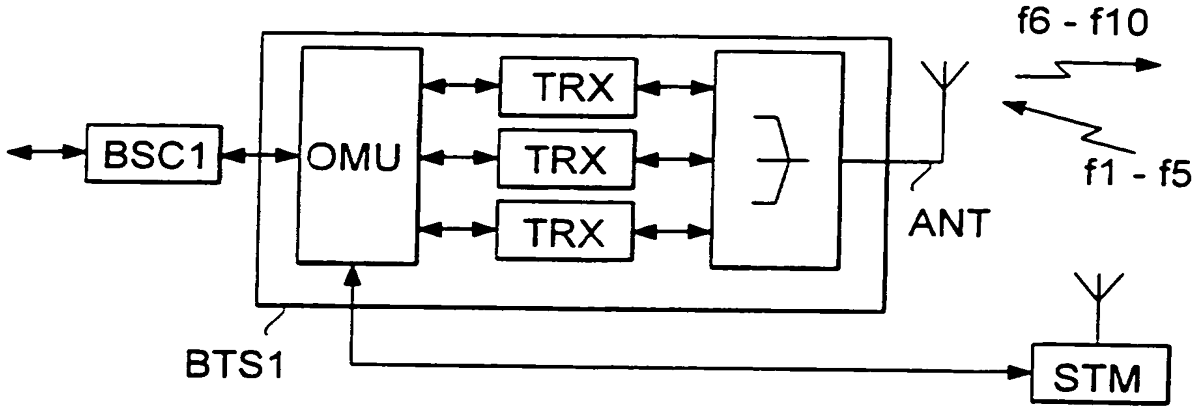

FIG. 1

CH	BTS RX-BAND	MS RX-BAND
f1	- 100 dBm	—
f2	- 102 dBm	—
.	.	.
.	.	.
.	.	.
f9	—	- 99 dBm
f10	—	- 90 dBm

FIG. 2

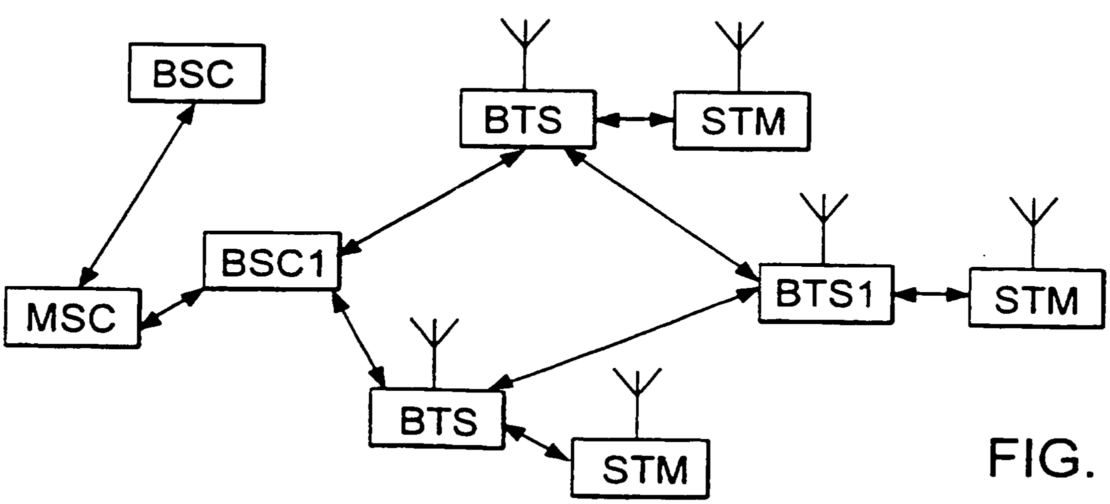

FIG. 3

CH	BTS1 RSSI	BTS2 RSSI
f1	- 100 dBm	- 88 dBm
f2	- 102 dBm	- 87 dBm
.	.	.
.	.	.
.	.	.
f9	- 99 dBm	- 90 dBm
f10	- 90 dBm	- 95 dBm

FIG. 4

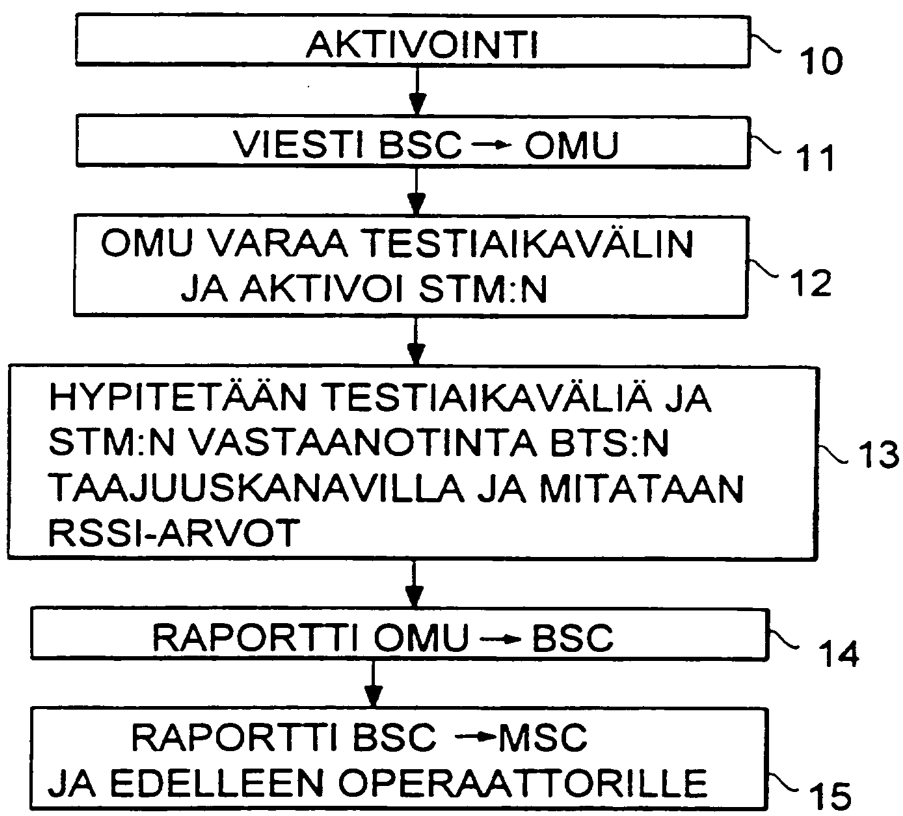

FIG. 5

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H04Q 7/34, 7/38, H04B 17/00

A3

(11) International Publication Number: WO 96/04760

(43) International Publication Date: 15 February 1996 (15.02.96)

(21) International Application Number: PCT/FI95/00403

(22) International Filing Date: 17 July 1995 (17.07.95)

(30) Priority Data:
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(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG).

Published
With international search report.

(88) Date of publication of the international search report: 18 April 1996 (18.04.96)

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f1	- 100 dBm	—
f2	- 102 dBm	—
.	.	.
.	.	.
.	.	.
f9	—	- 99 dBm
f10	—	- 90 dBm

(57) Abstract

The invention relates to a method for measuring the disturbance level of a base station environment, which base station (BTS1) comprises at least one receiver (TRX) utilizing frequency hopping, and means for measuring the signal level (RSSI) of signals received by said receiver. In order to carry out the measurements quickly and with ease, a free traffic channel is allocated in the receiver (TRX), said traffic channel is made hop sequentially through those frequency channels (f1 - f5) which the base station (BTS1) uses for reception, and the signal levels (RSSI) of the signals received on said frequency channels (f1 - f5) are measured, and a report on the measurement results is transmitted to the operator. The invention further relates to a cellular communication system which can utilize the method of the invention.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 95/00403

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04Q 7/34, H04Q 7/38, H04B 17/00
According to International Patent Classification (IPC) or to both national classification and IPC

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9211736 A1 (TELEFONAKTIEBOLAGET LM ERICSSON), 9 July 1992 (09.07.92), page 3, line 22 - page 4, line 8 --	1,3-5,10
A	FR 2696602 A1 (MOTOROLA, INC.), 8 April 1994 (08.04.94), abstract -- --------	1-10

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Date of the actual completion of the international search	Date of mailing of the international search report
6 February 1996	06 -02- 1996
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Malin Keijser Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT
Information on patent family members

05/01/96

International application No.
PCT/FI 95/00403

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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